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# (54) Means for reducing environmental pollution and toxicity from lead articles

(57) A lead article, e.g. lead shot or lead weight, coated with a coherent, wear-resistant coating of non-toxic but soft material, e.g. a solid film lubricant.

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SPECIFICATION

**Means for reducing environmental pollution and toxicity from lead articles**

The present invention relates to means for reducing environmental pollution and toxicity from lead articles, especially lead articles, used in field sports, such as lead shots and lead weights used in fishing. For the sake of clarity in this specification the term "lead article(s)" is intended to embrace any article(s) made entirely or partly of lead and/or a lead alloy.

Large quantities of lead shot are used in game shooting and some remain embedded within the game shot, whilst considerable lead shot waste (up to 95% and more) remains on the ground at the end of the shoot. Large quantities of lead weights used in fishing also remain in river beds. All these are sources of lead pollution in water and foods and recent medical evidence has emphasised the potential hazards to health of lead pollution which may be caused by the weathering of exposed lead articles leading to formation of soluble lead compounds.

Attempts have been made to overcome the pollution hazards of lead shot and lead weights by replacing the lead with an alternative material, especially steel. However steel shot is not satisfactory as it is too hard (Mohs hardness 5 to 8.5) and thus is prone to ricocheting and, when impacting a quarry, does not flatten but tends to pass right through the quarry. Furthermore steel shot tends to rust, so that in damp conditions the individual pellets can become bonded together. Lead, by contrast, is corrosion-resistant, soft (Mohs hardness 1.5) and readily fusible, and also dense, and there is no other material possessing such an attractive combination of properties.

It has also been proposed to coat lead shot with a substantial nickel coating but this also is unsatisfactory because it makes the shot very hard (Mohs hardness of nickel approximately 6) and markedly affects the spreading characteristics. Thus, nickel-coated lead shot tends to pass through the quarry, which makes its use less humane. In addition, nickel is very expensive. Accordingly, the use of such shot is restricted to shooting at "on edge" clay targets.

The present invention seeks to provide an alternative means for reducing the harm to the environment and toxic hazards stemming from ordinary lead shot, lead weights and other lead articles without adversely affecting the good properties of these articles to a significant extent.

According to the invention there is provided a lead article, as hereinbefore defined, which is coated with a coherent, wear-resistant coating of non-toxic but soft material.

It is essential according to the invention that the coating should be coherent (continuous), so that lead is not directly exposed to the ambient atmosphere, and that it should be sufficiently wear-resistant that it is not worn away in normal use of the article so as to expose the underlying lead, although it need not be fully abrasion-resistant to very hard abrasives. It is also necessary that the coating material should not be toxic or cause environmental pollution. Preferably the coating material should be sufficiently inert that it does not react chemically to any appreciable extent with materials with which it comes into contact during use of the lead article, as this would tend to expose the underlying lead.

It is a further characterising feature of the coating material that it should be soft. Preferably, it will be softer than lead, although it may have a comparable or even a slightly greater hardness (Mohs hardness up to about 2 or even about 3) than lead. Certainly, however, it must not be substantially harder than lead otherwise the benefit of the softness of lead will be lost entirely.

Another preferred feature for the coating is reasonable heat-stability, at least up to 100°C and preferably up to 250°C for lead shot and the like, so that a lead article embedded in foodstuff is unaffected when the foodstuff is cooked.

One class of material capable of satisfying the requirements for the coating material are to be found amongst solid-film lubricants, especially molybdenum disulphide and polytetrafluoroethylene, both of which have proved to be very satisfactory for the covering of lead shot, lead weights and the like.

The coating materials may be applied to the lead shot in any convenient manner, for example by a dip or barrel spray process, normally with the aid of an appropriate adhesive resin, followed by drying in such a way that a coherent (continuous) film is formed but there is no undesired adhesion, e.g. between individual lead shots. The coating need not be thick and thicknesses of 0.01 to 0.02 mm are satisfactory. If desired, more than one coating may be applied. A heat-curing stage may be employed, where appropriate, to improve the wear resistance of the coating.

The coatings may conveniently be composed of 25 to 95% by weight of molybdenum disulphide, polytetrafluoroethylene or the like bonded with an adhesive resin and such coatings are heat-stable at temperatures up to 280°C.

Such coatings do not affect the spreading power of lead shot to which they have been applied. Examination of such coated shot fired from a shotgun at a steel plate has shown that the coating does not flake off although it may become crazed under these severe and unusual conditions. Further, the coated shot has excellent weathering properties whilst undamaged and even the small proportion of used lead shot which has been damaged during use is likely to be considerably more weather-resistant than uncoated shot. Accordingly, considerable reductions in lead pollution are to be expected from using the coated shot.

The coatings proposed also have a long life-expectancy and high load-bearing capacity and are dirt-resistant, as well as being easily applied.

Another coating material which is satisfactory is aluminium. This may be applied by any convenient method to the lead article, e.g. lead shot or a lead fishing weight. One suitable method is the electrolytic process known as the "siegel" process which enables a thin, non-poisonous, weather-resistant coating to be deposited, which is both soft and

ductile so that it will deform with the lead shot on impact and will tend not to flake off. The coating may be extremely thin (e.g. several μm or even less) or may be thicker (e.g. up to 0.02 mm). Although the coating produced is corrosion-resistance, additional corrosion resistant can be imparted by anodising the coating, and this anodising can be of any colour for identification purposes.

It will be appreciated that aluminium is harder than lead although it is a relatively soft metal in its pure state. Aluminium is softer, for example, than copper (Mohs hardness of approximately 3).

CLAIMS

1. A lead article, as hereinbefore defined, which is coated with a coherent, wear-resistant coating of non-toxic but soft material.

2. A lead article according to claim 1, in which the coating material has a Mohs hardness of 3 or less.

3. A lead article according to claim 1 or 2, in which the coating material is reasonably heat-stable at least up to 100°C.

4. A lead article according to claim 3, in which the coating material is reasonably heat stable at least up to 250°C.

5. A lead article according to any of the preceding claims, in which the coating has a thickness no greater than 0.02 mm.

6. A lead article according to any of the preceding claims, in which the coating material is inert.

7. A lead article according to any of the preceding claims, in which the coating material comprises a solid film lubricant.

8. A lead article according to claim 7, in which the coating material comprises molybdenum disulphide.

9. A lead article according to claim 7, in which the coating material comprises polytetrafluoroethylene.

10. A lead article according to any of the preceding claims, in which the coating material is bonded to the lead article with an adhesive resin.

11. A lead article according to any of claims 1 to 5, in which the coating material comprises a metal deposited on the lead by electrolysis.

12. A lead article according to claim 11, in which the coating material comprises aluminium.

13. A lead article according to claim 11 or 12, in which the electroplated layer has a thickness no greater than several μm.

14. A lead article according to any of the preceding claims, in the form of lead shot.

15. A lead article according to any of claims 1 to 13, in the form of a lead weight.

16. A lead article, as hereinbefore defined, which is coated with a coherent, wear-resistant layer of protective material, the layer having a thickness no greater than 0.02 mm.

17. A lead article, as hereinbefore defined, constructed and arranged substantially as herein described.

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